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ABSTRACT

This sourcebook is an example of how environmental concepts can be introduced into various areas of the school curriculum. Included are a series of problems, projects, and exercises for students in grades four through ten. They are concerned primarily with pollution, population, individual needs, industrial needs, and consumption, on both a community and national scale. Each of the activities presents a particular problem, and students are asked to utilize their computational skills and/or suggest alternatives. The various problems and exercises aim to challenge students' problem-solving abilities in dealing with whole numbers, rational numbers, real numbers, percent and proportion, measurement, statistical measures, and graphs. Through generation of projects, students examine problems and suggest ways to improve environmental conditions. (BP)

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ENVIRONMENTAL EDUCATION

Problems, Projects, and Exercises

Adapted slightly with permission
from
POLLUTION: Problems, Projects, and
Mathematical Exercises

A publication issued by the
Wisconsin Department of Public Instruction

Division of Science Education
State Department of Public Instruction
Raleigh, N. C.
February 1972

SE 019 535

FOREWORD

In response to the North Carolina Environmental and Natural Resources Act and the recommendations of the curriculum committee appointed by that authority, the State Department of Public Instruction is proceeding with long-range planning for intensive effort in environmental education in Tar Heel public schools. This is being done in cooperation with local school system staffs, college and university education departments, experts in various phases of environmental science, and interested groups of citizens.

This publication is one of several intended for use in the opening stage of the interdisciplinary environmental education program. In the past, major emphasis on environmental concepts has been mostly in the biological field. The urgency and complexity of ecological problems requires that other disciplines, such as mathematics, English, history, civics, economics, and a wide range of sciences, incorporate environmental concepts and understandings in their curricula.

It is hoped that these publications will prove beneficial to the development of effective environmental education programs throughout North Carolina.

A. Craig Phillips
State Superintendent of Public Instruction

February 1972

PREFACE

With the kind permission of the Wisconsin Department of Public Instruction, this environmental education source book is being made available to North Carolina educators concerned with planning environmental education programs. It has been adapted slightly to make it more immediately suitable for classroom use in this state.

It is presented as a valuable example of how environmental concepts can be subtly introduced into various areas of the curriculum, both extending the students' awareness of environmental problems, and enhancing the relevance of the several disciplines.

Designed primarily to utilize the students' computational skills, the exercises contained in this source book are also intended to motivate teachers and students alike to further their understanding of environmental issues. The special problems section aims at challenging students' problem-solving abilities, and the projects suggest ways in which efforts may be made to improve environmental conditions.

To be effective, environmental education must permeate all levels of learning and must arouse genuine concerns for now and the future. It must be accorded more consideration than can be given in any single classroom during any one year, and it must include actual cumulative experiences that involve the student personally.

Jerome H. Melton

Assistant State Superintendent
for Program Services

February 1972

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INTRODUCTION

Pollution is a topic that has become almost uppermost in the minds of the people in America. Man, in his efforts to control his environment, has in many ways upset the world in which he lives. Man is dependent upon vast amounts of pure air, water, and food for his life. His food supply depends upon the plant and animal life about him. To maintain these necessities, or to increase the amounts of these necessities to keep up with an evergrowing population, he has developed many so-called improvements, including tremendous machines to reshape the landscape; detergents to eliminate dirt from his clothing, food, and body; and chemicals to destroy insect life and plant life that he has found obnoxious to his way of living. In the processes used to develop these improvements, he has inadvertently polluted the environment that he had hoped to control.

Man, acting in his supremacy for thousands of years, has now been awakened to the fact that he has but a short, short time in which to bring about a rebirth of his ecology. The world, that he thought abounded with unlimited natural resources, has now been revealed as a fragile and delicate earth. A crisis has arrived, and man now faces the responsibility of undoing much of what he has done in the past so that future generations may live in an environment that enhances their very existence and does not threaten and continue to destroy the basic necessities of life.

Action to bring about this rebirth of our world is needed now. It is the responsibility of people in all walks of life. We as educators cannot shrink away from our share of this tremendous task. One way that we can assume our part of this challenge is to expose our students (through mathematics) to the causes of the situation and alert them to ways in which they can respond to the challenge that faces each one of us today if we are to live tomorrow!

PROBLEMS

1. According to a 1970 estimate, people in the United States used approximately 30,000,000,000 cans a year.

   a) If we estimate that the population of the United States for that year was 202,000,000, what would be the average number of cans used per person? (to the nearest whole number)

   b) If these are aluminum cans and on the scrap market they are worth ½¢ each, what would be the worth of the cans an average individual uses in one year? (to the nearest whole cent)

   c) For your class?

   d) For your community? (use rounded numbers for the population of your community)

   e) If the average life span is 75 years, how many cans would a person use in a lifetime?

2. The average American produced slightly more than 4 pounds of solid wastes a day in 1970. It is estimated that by 1980, every American will produce about 5.5 pounds of solid waste a day.

   a) How much solid waste was produced in one year by an average American in 1970?

   b) About how much was produced in 1970 by your community in a day? In a year?

   c) How much more solid waste will an average American produce in the year 1980 than he did in the year 1970?

3. The average American uses 60 gallons of water per day in the home. About 24 gallons of this water is used for flushing toilets. Each toilet flushing uses about 6 gallons of water. (1 gallon = 231 cubic inches) If you would place a brick whose dimensions are 2 inches by 4 inches by 8 inches in the toilet storage tank, how many gallons of water would you save in an average week?

4. If you had to carry the water that the average American uses in the home each day, how many pounds of water would you have to carry?

   Note: The average American needs about 60 gallons of water per day for residential use. A cubic foot of water weighs 62½ lbs.

5. The birth rate is the number of births per thousand per year.

$$\text{birth rate} = \frac{\text{total number of births per year}}{\text{total population}} \times 1{,}000$$

The death rate is the number of deaths per thousand per year.

$$\text{death rate} = \frac{\text{total number of deaths per year}}{\text{total population}} \times 1{,}000$$

Rate of natural increase = birth rate - death rate

I. Using the information above, complete the table.

Area	Population	Births	Deaths	Birth Rate	Death Rate	Natural Increase	Percent Increase
U. S.	203,000,000	3,571,000	1,923,000				
N. C.	5,100,000	94,000	45,000				
Your Community							

II. In Central America, the birth rate is 45 per thousand but the death rate is 11 per thousand.

a) State the birth rate as a percentage.

b) What is the rate of natural increase?

c) What is the percent of increase?

d) At a birth rate of 45 per thousand, how many births would there be out of 238,000 people?

III. By mid-1970, we had about 3.6 billion people in the world.

a) At an annual growth rate of 1.9%, what would be the population by mid-1971? By mid-1972?

IV. The population of South America in 1965 was 240,000,000. It is predicted to be 624,000,000 by the year 2000.

a) What would the amount of increase be?

b) What would the percent of increase be?

6. In a set of automobiles, 12 have engines under 300 horsepower, 14 are blue, 13 have fiberglass belted tires, 7 are blue and have engines under 300 h.p., 5 have fiberglass belted tires and engines under 300 h.p., 6 are blue and have fiberglass belted tires, 4 are blue and have engines under 300 h.p. and have fiberglass belted tires. What is the number of automobiles in the set?

7. The number of automobiles in use in the United States in the year 2000 is predicted to be seven times as many as in 1947. The number in 1970 was 2.6 times as many as in 1947. If the automobiles in Los Angeles County were responsible each day in 1970 for putting 30 tons of deadly sulfur dioxide into the air, and the predicted growth of the United States automobile population is accurate, how many pounds per day of sulfur dioxide will be put into the air in Los Angeles County in the year 2000?

8. In 1964, the population of the United States was about 190 million people. The per capita consumption of beef per year was 106.6 pounds (carcass weight).

   a) How many million pounds of beef was corsumed in 1964 in the United States?

   b) If each cow weighs about 1,000 pounds, then how many cattle were needed to produce the beef in 1964?

   c) If the projected consumption of beef is 117 pounds per person in 1980 and the projected population is 270 million people, how many 1,000 lb. cattle will be needed to produce sufficient beef in 1980?

   d) If each cow needed in 1980 was a year to 1½ years old and the waste produced by each cow is 23,600 grams per day, then how many metric tons of waste will be produced in 1979 by these cattle?

9. If air pollution, causing the sun's heat to be trapped, increases the average daily mean temperature of the earth by 0.1 degree C each year, and if the average daily mean temperature of the southern polar ice cap was -75 degrees F in 1970, by what year will the average daily mean temperature of the southern polar ice cap be 32 degrees F (ready to melt)? If it takes 80 times as much heat to melt ice at 32 degrees F as it does to increase the temperature of the same weight of water 1 degree C, in what year will the southern polar ice cap be melted according to the information in this problem?

10. The age of the air polluter now plus the age of the water polluter 6 years ago is 3 times the number of gallons of water used for bathing by an average American each day. Six years ago the air polluter was half again as old as the water polluter was. Fourteen years from now

(in the future) the air polluter will be one and one-fourth times as old as the water polluter. How many gallons of water does an average American use for bathing in a week?

11. A 1965 automobile of a certain make and model pollutes the air 5 times as much as a 1970 automobile of the same make and model. The 1965 auto started at the beginning of a section of highway traveling 50 mph at a steady rate. Two hours later, the 1970 automobile started at the same place and traveled in the same direction at a steady rate of 65 mph. If the 1970 car pollutes the air at the rate of n cubic feet per hour, how many n cubic feet of pollutants were emitted by each car by the time the 1970 car caught up to the 1965 car?

12. One calorie of heat will raise the temperature of one gram of water 1 degree C. If the average American uses 16.8 gallons of hot water per day, and the average American home hot water heater raises the temperature of its water 125 degree F, how many calories of heat are required to supply hot water to the average American during one week?

13. BOD is a unit of measure in the study of pollution. What is this unit of measure? In what phase of pollution is it used?

14. Ecology is a branch of science dealing with the relations between living organisms and their environment. How many different ways can you read the word "ecology" in the following array, beginning with an "E" and ending with the "Y"? (you may "zig-zag" at right angles)

Note: Before you begin, guess an answer.

```
                E
              E C E
            E C O C E
          E C O L O C E
        E C O L O L O C E
      E C O L O G O L O C E
  E C O L O G Y G O L O C E
      E C O L O G O L O C E
        E C O L O L O C E
          E C O L O C E
            E C O C E
              E C E
                E
```

15. Four "polluters" met in Raleigh. Their names were Andrew, Robert, Thomas and Howard. Their "polluting" specialties, one for each, were noise, water, land, and air, but not necessarily respectively. Andrew, Robert, and the land polluter came from the east and the noise polluter came from the west. Their favorite sports were: the air polluter--tennis, Thomas--baseball, the noise polluter--football, and the land polluter--baseball.

Andy and the land polluter were married and the rest were single. The tennis fan's wife was the noise polluter's sister, and her sister lived with her brother in Los Angeles County. Thomas had been divorced once, then remarried to the same woman, his present wife. Robert had never been married. The tennis fan came from the east, but his wife stayed at home.

Name the air, water, land, and noise polluters.

16. Encircle all mathematical and ecological symbols or words. Words may be horizontal, vertical, or diagonal. Some words may be in reverse order. See if you can identify 50 words or more, other than those marked as examples.

S E V E N U P E R C E N T I M E
G N I L C Y C E R N S I R A T S
D O Y G O L O C E S I N A T E A
E D I V I D E V X D O E S I N E
T D D E P L E T I O N M H N U R
E P O H I D C V P I S A O O L T
R L A N D F I L L L U C B D L C
G I N M E D D M U S Q U A R E O
E A V A E G U M A L U B A N U N
N L R E M E J I P I T E R M S S
T I I B R Y E A R C I R C L E E
S T O F A S R Q A K J O L A I R
O T T E H G P R O D U C T U T V
A E R U S D E E P S N K U N I A
P R D N E D D A E R K S E I C T
U K E A T A N G E N T M T O L I
M A P O L L U T I O N N S N E O
R S L L P E A G F O X O M U D N
O R E I O W G Y R A T I O N O A
T A T T Y T M I N U S N G U M R
C Y I L O A Y L E C R U O S E R
A C O N E N O I T C A R F E N U
F I N O E D A Y E F I L D L I W

PROJECTS

DO WE CARE?

In which group do you place yourself?

Group 1: Yes, we do have an environmental pollution problem. What can we do about it?

Group 2: I don't believe pollution is as bad as they say.

If you, as a mathematics educator, belong to group 1, then there are some things you can do about it.

A. You can become informed. Sources of information include:

"Conservation News"
National Wildlife Federation
1412 Sixteenth Street, N. W.
Washington, D. C. 20036

"C. F. Letter"
Conservation Foundation
1250 Connecticut Avenue, N. W.
Washington, D. C. 20036

Resources and Man
National Academy of Sciences-
National Research Council
San Francisco, California
W. H. Freeman and Company. 1969

Group for Environmental Education, Inc. (GEE)
1214 Arch Street
Philadelphia, Pennsylvania 19107

The Nature Conservancy
1800 N. Kent Street
Arlington, Virginia 22209

B. You can become involved in and/or support groups in your community concerned with conservation of environment. You can write your elected officials and express your concern. You can become involved in the election process and help place in office people who are concerned about pollution.

C. You can help make young people aware of the rapidly increasing rate of pollution. As mathematics educators we are in a fine position to incorporate environmental pollution into our curriculum. Each teacher's own ingenuity and creativity can help him or her carry out an ecological underlying theme during the teaching of mathematics. Projects initiated and problems presented can provide pupils with relevant information concerning environmental pollution and with needed practice of fundamental mathematical skills.

1. Take a "litter count" in various hallways of your school. Keep a frequency count of the types of litter at various locations.

   What could you as a class or individual do to improve the situation?

2. How many trees are used to make the newsprint for your newspaper in a year if it takes 17 trees to make a ton of newsprint?

   Suggested approach: Collect the newspaper used in your home for a week. Weigh this and determine the approximate weight of newspaper you would use in a year. How many trees were used in making that amount of newsprint?

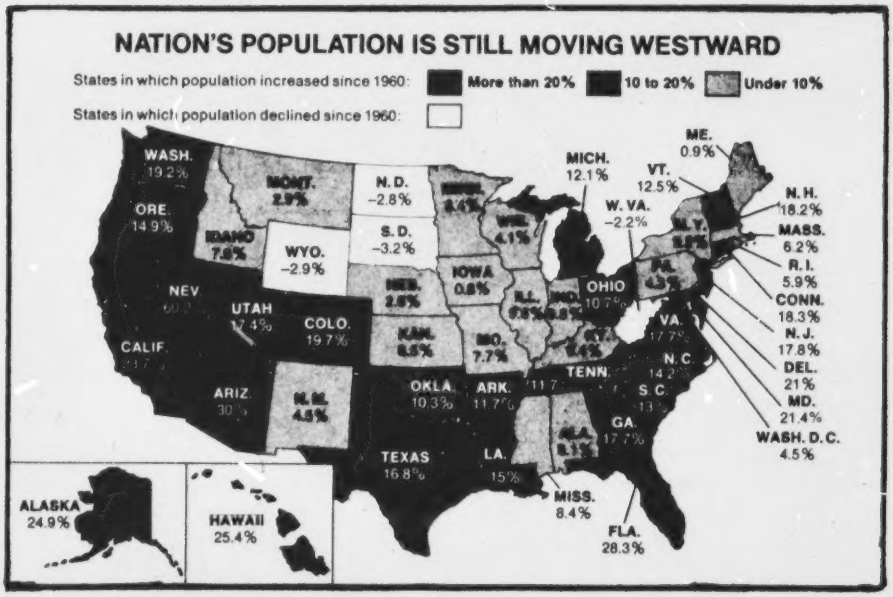
3. Hot Lunch Survey. Have students get permission to conduct a survey of wasted food in the school cafeteria. Appoint pairs of students (for each type of food served daily) to tally the amounts of food not consumed and milk which is not drunk. Students should continue their surveys for a couple of weeks, if possible. Compiled data can be presented graphically to school officials in hopes of cutting down on the waste.

   Some sample questions you might be able to answer:

   What foods are most frequently wasted?

   Does the type of food wasted vary with the time of the year?

4.



4. (Continued)

Using the information given on the map on page 10, illustrate the increase and decrease in population for each state in the United States, either on a bar graph, histogram, or a line graph.

What problems do you see being created for states such as North Carolina, Nevada, California, Arizona, Florida, Maryland, and Delaware? How would the problems for North Dakota, South Dakota, Wyoming, and West Virginia differ from those in the above-named states?

_____ _____ _____ _____ _____ _____ _____

On an outline map of the United States, use the following key to illustrate the information shown on the map on page 10.

More than 50%	color black	10-14.9%	color brown
30-49.9%	color gray	5- 9.9%	color green
25-29.9%	color red	0- 4.9%	color blue
20-24.9%	color orange	(-5)-(-.1%)	color white
15-19.9%	color yellow		

Compare your map to the original. Does one offer advantages over the other? If so, what are the advantages or disadvantages?

SUGGESTION: Develop your own key for coloring a similar map instead of using the key above.

5. If possible, visit a road construction site where a cut has been made so layers of earth are exposed. Measure the depth of the topsoil. For nature to build one inch of topsoil requires approximately 500 years. At this rate, how many years were needed to build the topsoil at the site you visited?

If, through careless management of that topsoil, 1% of it is caused to erode away in 1 year, how much would erode away in a year? How many years would it take to destroy all of the topsoil at that rate?

When you visited the site, was there any evidence of erosion? Was there any evidence that man had done anything to prevent this erosion? What conclusions can you come to from this study?

6. Make plans to take a poll of 50 housewives (or if more convenient, two housewives per pupil, and plan so that there will not be duplication of households). Use these questions or develop a set of your own that might be more relevant to your community.

Would you be willing to pay 8% more for an air conditioner if it made less noise? More specifically, would you pay $310 as compared to $288?

Would you be willing to pay $99 for a less noisy vacuum cleaner if the same model, but noisier, was available for $90?

6. (Continued)

Would you be willing to pay $1.25 more for a less noisy hair dryer?

Would you be willing to pay $5.00 more for a less noisy lawn mower?

Tabulate your results on a chart similar to the one shown here.

ITEM	"YES"		"NO"		"UNDECIDED"	
	NO.	%	NO.	%	NO.	%
Air Conditioner						
Vacuum Cleaner						
Hair Dryer						
Lawn Mower						

If you can come to any conclusions that might influence a manufacturer of one of these items, why not write to such a manufacturer explaining what you have done and offer some concrete suggestions to him for future production plans. Wouldn't it be interesting to find out if the company would respond to your suggestions?

7. How can we use math to better understand the population explosion? Take a look at what has happened in India with the death rate (deaths per 1,000 people) since 1921.

1921	48.6 deaths per 1,000
1931	36.3 deaths per 1,000
1951	27.4 deaths per 1,000
1966	16.0 deaths per 1,000

In 1970, the birth rate was approximately 41 births per 1,000 people.

Make a bar graph or histogram that will illustrate the above information. (Use one color to show the death rate and a different color to show the birth rate for 1970.)

What conclusions can you draw from studying the graph?

a) If the death rate is the same in 1970 as in 1966, how many more babies were born in 1970 per 1,000 than there were people dying per 1,000? (rate of natural increase)

b) If India's population was approximately 524,000,000 in 1970, then how many babies would have been born in 1970?

7. (Continued)

   c) How many people in India would have died in 1970?

   d) How much would India's population have increased in 1970?

   e) What would be the percent of increase? (to the nearest tenth)

8. Make plans to take a count of cars traveling certain routes, at certain hours, on various days in your community.

   Suggestions:

   Go to the location you have chosen. Count the cars traveling in one direction and the number of passengers in each car. Do this for ½ hour during a morning rush hour, ½ hour during an evening rush hour, and ½ hour during a midday hour.

   Determine how many days you will do this and vary your days so that some are weekdays and some on weekends.

   When you arrive at what you feel is a fair sampling, determine how many fewer cars would have been needed if each car would have carried 3 passengers.

   Determine what percent of the cars carried only 1 person; 2 persons; 3 persons; more than 3 persons.

   What conclusions can you form as an individual or as a group carrying out this project? Can you use these conclusions to make some recommendations to your own family (families)? To the staff of your school? To the members of your community? To your traffic department?

9. How much and what kind of litter exists in your community? Can we count every piece of litter in the community to determine the answer to the above question? How can we find a reasonable answer to the question?

   A suggested procedure:

   1. Get a map of the city and determine sample locations.
   2. Establish a unit area for each location. (Example: 100 square ft.)
   3. Measure to determine the unit area in each location and collect data from that sample area.
   4. From the sampling, make a prediction for the entire community.

10. How much concrete, asphalt, or gravel covers the lot where you live? (buildings, patio, driveway, etc.)

    a) Compute the area in square feet.

    b) Compute the percent of area covered by concrete, asphalt or gravel for each individual lot of the class members.

    c) Determine the average for your class.

    d) Based on the class average, what would be your prediction for the community?

11. If you are in the habit of letting the water run when you brush your teeth, try this plan. The next 5-10 times you brush your teeth, put a container under the faucet and catch the water that would have run down the drain. Measure the amount and arrive at the average number of pints, quarts, or gallons that would have gone down the drain. If you brush your teeth on the average of 3 times a day, how much water would you use in 1 day? If there are 4 members in a family, what would such a family waste in 1 day? 1 week? 1 year?

    If you limited yourself to using just 1 cup (standard measuring cup) of water to brush your teeth, what fractional part would this be of the water that you used when letting the water run? Can you express this savings as a percentage?

    There are 7½ gallons of water in a cubic foot. How many cubic feet of water would the family of 4 have used in the year? Find the cost of a cubic foot of water in the community in which you attend school. Find the cost of the water used then by a family of four in your community.

12. Make a check of your home for loss of water. (Turn off all water taps in the house and outside. Watch on your water meter the "one cubic foot" or "ten gallon" indicator to see if it moves. By timing the movement, you can determine how many cubic feet or gallons per minute are being lost.) According to your observations, how many gallons of water are lost in your home per day?

    If the loss of water is ½ cubic foot in 5 minutes, how many gallons would be lost per hour?

13. It has been observed that there may be sharp but short peaks of sewage flow every hour and half hour during the evening at times when commercials come on television. As a matter of fact, measurements of water pressure fluctuations have been taken by some organizations to test the effectiveness of commercials.

    Check with the community water supply and sewage disposal supervisor to see if the above observations are valid. Collect data over a period of time to prove your answer.

EXERCISES

Whole Numbers

1. Doctor Richard Wang of Milwaukee reported that his interviews in six months with drug patients in the county hospitals revealed that 37 patients began by using marijuana, 24 used heroin first, 6 began with codeine, 6 began with amphetamines, 5 started on LSD, 3 first used barbiturates, 3 began with morphine, 2 first used cocaine, and 1 started by sniffing glue. How many patients did he interview?

2. Some states banned DDT in 1970. However, DDT, once in the food chain, circulates for another 15 years. If this is so, and assuming that there is no other source of DDT contamination, in what year would those states finally be freed from the effects of this chemical?

3. Erie County in upstate New York is one of the worst air polluted areas in the United States. In a study of the residents of the county, it was found that the number of people dying from respiratory diseases is doubling every 5 years. If in 1960, there were 263 deaths attributed to respiratory diseases, about how many would there be in 1965? In 1970? In 1980?

4. A 1965 automobile emits an average of 900 parts per million of hydrocarbons in its exhaust to pollute the air. A 1970 automobile emits a corresponding 180 parts per million. How many 1970 automobiles does it take to pollute the air with hydrocarbons as much as one 1965 automobile?

   (Air pollutants are most often reported in micrograms per cubic meter ($\mu g/m^3$). Specific conversion factors are required to convert ppm to $\mu g/m^3$ because each pollutant has different physical characteristics. In the case of hydrocarbons, 1 ppm = $655\,\mu g/m^3$.)

   How many $\mu g/m^3$ of hydrocarbons does a 1970 model emit?

5.

	Land Area (in thousands of sq. km.)	Population (in millions)
Asia and Far East	21,178	1,483
Soviet Union	22,403	205
North America	21,483	189
Latin America	20,501	192
Rest of the World	49,770	726

Using the above table, find the total land area (in thousands of square kilometers) and the total population (in millions).

6. Assuming that the average amount of rubbish disposed of each day by the citizens of Durham is 5 pounds and the population of Durham in 1970 was 95,438, how many pounds of rubbish were thrown away in 1 day? In 1 week? In 1 year? How many tons would this be in 1 year?

   (The garbage bill for all of America in 1970 came to three billion dollars.)

7. For fiscal year 1968, the United States Congress appropriated $200 million for clean water measures. This expenditure is compared with $450 million authorized by the Congress in 1966. Find the decrease in appropriations from 1966 to 1968.

8. In his lifetime, an average American will personally

   ...pollute three million gallons of water

   ...use 21,000 gallons of leaded gasoline containing boron*

   ...drink 28,000 pounds of milk

   ...eat 10,000 pounds of meat

   Using these figures, how much of each of these products would be consumed by a family of 5 in their lifetimes? By a community of 5,000?

9. If the U. S. population in 1870 was 38,558,000 and the U. S. population in 1960 was 178,464,000, how many fewer people were there in the U. S. in 1870 than in 1960?

10. On a recent TV show, it was stated that soon men will be able to walk on the Hudson River water. From the west side of Manhattan Island, 300,000,000 gallons of raw sewage are pumped into the Hudson River each day. How many gallons of raw sewage are pumped into the Hudson River in 1 year?

11. In order to propel food from a pressurized can, a gas called Freon c-318, octafluorocyclobutane, has been approved by the Food and Drug Administration as harmless and thus suitable for human consumption. In 1964, about 110 million cans of aerosol-dispensed food were sold. At this rate, how many cans of aerosol-dispensed food will be sold in 4 years? In 8 years?

---

*Do you know that lead is a known poison and is readily absorbed by skin and mucous membranes? When the quantity of lead in the body reaches a high enough level, it interferes with the development of red blood cells and development of hemoglobin. Boron is also toxic and can cause damage to the central nervous system.

12. If it takes 17 trees to make a ton of newsprint, how many trees would it take to make 53 million tons of newsprint?

13. During 1968 in the United States, gasoline service stations disposed of 350,000,000 gallons of used oil. If each U. S. car serviced provided an average of 4 gallons of used oil, how many cars in the United States contributed in 1968 to the service station used oil disposal problem?

14. To meet overall needs of the average community, a water utility must supply 150 gallons of clean water per person each day. Use the population of your community to compute the amount of water that must be produced by the water utility--

    a) each day
    b) each week
    c) each month
    d) each year

15. For residential purposes, the average American uses 60 gallons of water each day. As an average American, how much water would you use in a week?

16. Commercial operations use about 20 gallons of water per day per person. How many days of commercial operation are needed to use 600 gallons of water per person?

17. About 10 gallons of water per day per person is lost through breaks in pipelines. In 1 year, how much water is lost with no benefit to the people in your community?

18. If each day a 2-year-old steer weighing 700 pounds drinks 12 gallons of water, how many gallons will be required to water 1,000 steers in a day?

19. If it requires 1,400 gallons of water to produce a dollar's worth of steel, how many gallons would be used to produce $50 worth of steel?

20. Industry uses, on the average, 50 gallons of clean water per day per person from the public system. It takes about 500 gallons of water to produce 1 gallon of gasoline. If all of the industry's water per day was used to produce gasoline, then how many gallons of gasoline could be produced in a community of 50,000 people?

21. The paper industry needs about 90,000 gallons of water for each ton of paperboard produced.

    a) How many gallons of water does it take to produce 1 pound of paperboard?

    b) If 53 million tons of paperboard are produced each year by the paper industry, then how many gallons of water would be used each year?

22. $X = 5n + 14{,}210{,}000$ where X represents the U. S. population in 1970 and n represents the U. S. population in 1870. If the U. S. population in 1870 was 38,558,000, what was the U. S. population in 1970?

23. Because of pollution, caused by millions of people, the natural life of Lake Erie was cut by some 15,000 years in just over a half a century. If this is so, an average of how many years were cut off of its natural life in the span of just 1 year?

24. During the 20 years from 1790 to 1810, the population of the United States increased from 3,929,000 to 7,239,000. During the 20 years from 1950 to 1970, the population of the U. S. increased from 150,697,000 to 207,000,000.

    a) What was the population increase in the U. S. (number of people) from 1790 to 1810?

    b) What was the population increase in the U. S. (number of people) from 1950 to 1970?

    c) How much greater was the increase in U. S. population from 1950 to 1970 than from 1790 to 1810?

    d) What was the population increase in the U. S. from 1810 to 1970?

25. When the sulfur dioxide content of the air in New York City rises above .2 parts per million, 10 to 20 people die as a result. In the 5 years, 1965 to 1970, sulfur dioxide reached this level once every 10 days.

    a) What was the minimum number of people who died in New York City during the 5 years, 1965 to 1970, as a result of air pollution by sulfur dioxide?

    b) What was the maximum number of people who died in New York City during the 5 years, 1965 to 1970, as a result of air pollution by sulfur dioxide?*

26. Refer to the figure on the following page.

    a) How many billion tons of CO_2 are added to the earth's atmosphere each year that are not used up in nature's normal cycle?

    b) How many tons of CO_2 are taken out of the earth's atmosphere per year by natural processes?

---

*No death certificates have ever cited polluted air as a cause of death. Yet, the U. S. Surgeon General reports there is "compelling evidence" that air pollution is killing and disabling Americans in every area of the nation. Lung cancer, emphysema, asthma, and bronchitis are aggravated by air pollution.

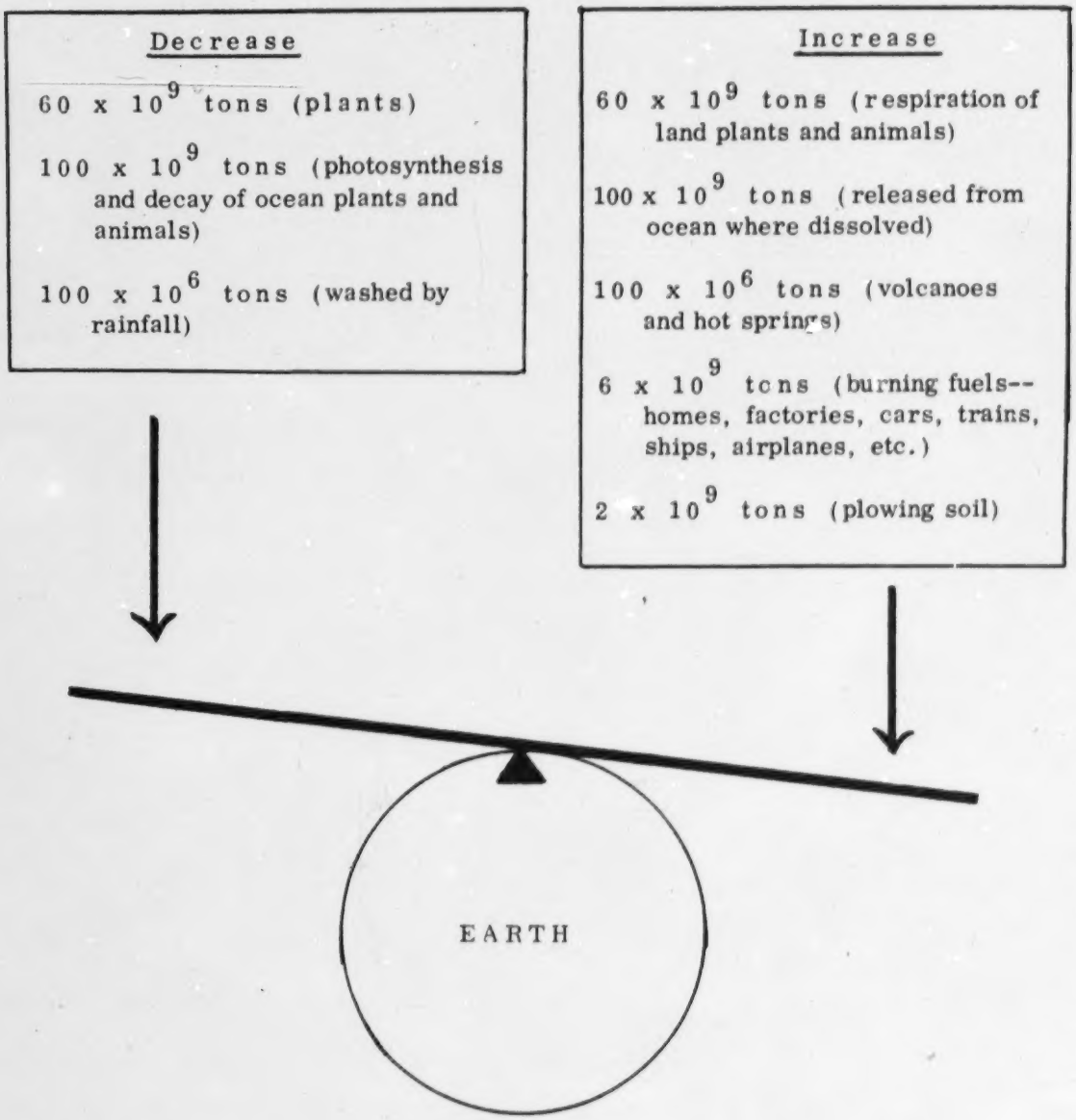
26. (Continued)

c) How many pounds of CO_2 are put into the earth's atmosphere per year by natural processes and man's activities?

d) Do land plants use more CO_2 from the air than volcanoes put into the air?

EARTH'S ATMOSPHERE'S CO_2 BUDGET

(UNBALANCED!)


Decrease
60 x 10^9 tons (plants)
100 x 10^9 tons (photosynthesis and decay of ocean plants and animals)
100 x 10^6 tons (washed by rainfall)
Increase
60 x 10^9 tons (respiration of land plants and animals)
100 x 10^9 tons (released from ocean where dissolved)
100 x 10^6 tons (volcanoes and hot springs)
6 x 10^9 tons (burning fuels--homes, factories, cars, trains, ships, airplanes, etc.)
2 x 10^9 tons (plowing soil)
EARTH

Rational Numbers

1. Every year, affluent Americans throw away over 30 million tons of paper, 4 million tons of plastic, 48 billion cans, and 26 billion bottles.

    a) If each can weighs ¼ lb. and each bottle weighs ½ lb., what is the total tonnage thrown away every year?

    b) How many more tons of paper than cans are thrown away?

2. During Pittsburgh's years of air pollution, a sample of iron exposed to the city's air corroded 2½ times faster than a similar sample at a rural state college. This means that a sheet of iron with a 15-year life-span in the rural state college will have a life span of how many years in Pittsburgh?[1]

3. One gallon of fuel oil consumes 90 pounds of air in the combustion process. If a homeowner uses fuel oil to heat his home and uses 7½ gallons per day, how many pounds of air will be used in heating his home 30 days?

4. The Aswan Dam project, built on the Upper Nile River, stopped the flow of nutrient-rich silt from reaching the Mediterranean Sea.[2] Without this silt, the Egyptian sardine catch declined from 18,000 tons in 1965 to 500 tons in 1968. What fractional part of the 1965 catch was reaped in 1968?

5. In 1970, it was estimated that about 2/3 of the people of the world go to bed hungry. There are in the world approximately 3½ billion people. At that rate, approximately how many people go to bed hungry?

6. There are about 2¼ Americans for each vehicle that is in use. If there were 203 million Americans in 1970, about how many vehicles were being used?

7. Approximately 90 million vehicles are used by Americans. If each year 2/25 of these vehicles are junked, how many vehicles do we need to dispose of each year?

---

[1]Paint discoloration; discoloration and erosion of stone; fading and weakening of fabrics; weakening of leather, paper, and rubber are other material damages caused by air pollution.

[2]The Aswan Dam also flooded areas which caused an increase in snails. These snails are intermediate hosts for a parasitic fluke that infects man. Many more Egyptians are dying from infestation by this fluke since the dam was built.

8. Since early times, man has struggled with his environment--won temporary benefits and then lost. The bubonic plagues in the 1300's destroyed ¼ of Europe's population. From 1918-1920, a global flu killed 25 million people. If such a flu epidemic should strike the world in 1970, what fractional part of our world population would be killed? (World population estimated to be 3½ billion.)

9. One-fourth of the land of the world is arable. How many acres are suitable for crops if the world contains approximately 32 billion acres of land?

10. An amount of land equal to the arable land can be used best for grazing. The remaining part includes wastelands, tundra, desert, and mountains. What fraction of the total is represented as wastelands, tundra, desert, and mountains?

11. In America 4/5 of our population lives in cities that occupy 1/50 of our land. If the area of the United States is approximately 2,800,000 square miles and our population is approximately 205 million people, how many people live in cities and how many square miles of land do they occupy?

12. The following figures are an estimate of what it would cost to accomplish an "acceptable" cleanup over a 5-year period: water, $26-29 billion yearly; air in metropolitan areas, $12-15 billion yearly; and solid waste disposal, $15 billion yearly.

    a) What would such a program cost for 5 years using the minimum figures? The maximum figures?

    b) If our population in those 5 years averaged 210,000,000, what would be the cost per each man, woman, and child for this cleanup, based upon the minimum figures? Based upon the maximum figures?

13. If the U. S. population in 1970 was 23/7 of the U. S. population in 1890, and the U. S. population in 1970 was 207,000,000; what was the U. S. population in 1890?

14. Plot the following ordered pairs on graph paper and connect the points in order:

(-4, -5)	(4, 0)	(-4, 6)
(-3.5, -5.5)	(4, 6)	(-3.5, 5.5)
(-3, -5.8)	(3.5, 6.5)	(-3, 5.2)
(-2.5, -5.9)	(3, 6.8)	(-2.5, 5.1)
(-2, -6)	(2.5, 6.9)	(-2, 5)
(0, -6)	(2, 7)	(2, 5)
(2, -6)	(0, 7)	(2.5, 5.1)
(2.5, -5.9)	(-2, 7)	(3, 5.2)
(3, -5.8)	(-2.5, 6.9)	(3.5, 5.5)
(3.5, -5.5)	(-3, 6.8)	(4, 6)
(4, -5)	(-3.5, 6.5)	

Connect (-4, 6) to (-4, -5) What polluting article does this represent?

Real Numbers

1. If 48 billion cans are used annually in the United States (aluminum cans) and there are 207 million people, how many cans are used per person per year?

2. In Charlotte, N. C., population increased approximately 20% between 1960 and 1970, Raleigh increased approximately 30%, and Greenville increased approximately 27%. Indicate each of these percents as a fraction and as a decimal.

3. If the population of the United States in 1910 was 91.972 million and the population of the United States in 1960 was 178.464 million, how many million fewer people were there in the United States in 1910 than in 1960?

4. In 1949, New York City had the most polluted air and the highest death rate from pneumonia in the State of New York--31.5 per 100,000 population. In 11 upstate cities with much cleaner air, the rate was only 23.9 per 100,000. In rural areas, where pollution was least, the death rate was lower still--16.9. In 1959, all rates increased. Then New York City had 50.6 pneumonia deaths per 100,000; the upstate cities had 38.6, and the rural areas had 29.2.

   a) What was the rate of increase in New York City from 1949 to 1959?

   b) How much higher was the rate in New York City than the rural areas in 1949?

   c) What was the rate of increase in the upstate cities from 1949 to 1959?

   d) How much higher was the rate in New York City than the rural areas in 1959?

5. In 1970, there were only 2.6 agricultural acres per person in the United States populated by 203 million Americans.

   a) How many acres of agricultural land were utilized in 1970?

   b) We are destroying our agricultural land at a rate of about a million acres a year. At this rate, how many acres will be utilized in 1971? In 1981?

   c) If the population in 1981 is 272 million, how many acres of agricultural land per person will there be?

6. If each American is 50 times as much of a burden on his environment as each person in India, we 203 million Americans have the same impact on our environment as how many Indians?

7. At the time of takeoff, a four-engine jet pours out 88 pounds of air pollutants. If such a plane takes off every minute from an airport, how many pounds of pollutants are poured out into the air in 1 hour? In 1 day? In 1 week? In 1 month (30 days)? In 1 year? Convert all of these answers to tons.

8. 203,000,000 Americans contribute each year

...142 million tons of smoke

...7 million junked cars

...48 billion cans

...26 billion bottles

a) As an average American, what is your personal contribution of each of these items in a year?

b) Supposing you lived 70 years, what would your lifetime contribution of each of these be?

9. In the United States, the annual average solid waste collection is 5 pounds per person per day. With a population of 203 million, how many tons per day would this be? With a population of 5 million in North Carolina, how many tons per year would this be?

10. Aggravated by air pollutants, emphysema is the fastest growing cause of death in our country today. In the 10-year period from 1950 through 1959, deaths among males from emphysema rose from 1.5 per hundred thousand to 8 per hundred thousand. This total has increased steadily. In 1970, the population of the United States was 203 million and 50,000 persons died from emphysema. How many people per hundred thousand died from emphysema?

11. By January 1970, the United States population was approximately 206 million people. The birth rate was 17.4 births per 1,000 people and the death rate was 9.6 deaths per 1,000. Using this information, answer the following questions:

a) Approximately how many million births were there during 1970?

b) How many million deaths?

c) What would the United States population in millions be in 1971?

12. In 1967, United States passenger cars totaled 80,414,000. They emitted 61,000,000 tons of carbon monoxide into the air.

a) On an average, each car was responsible for emitting how much carbon monoxide into the air?

b) At that rate, 1 person driving a car for 50 years would have caused how much carbon monoxide to pollute the air?

Using the following statistics, answer the same 2 questions for these chemicals:

Hydrocarbons	16,000,000 tons in 1967
Nitrogen Oxides	6,000,000 tons in 1967
Lead	210,000 tons in 1967

13. Loudness of sounds is measured in decibels.[1] According to scientists, sounds above 85 decibels can eventually damage the human ear.[2] A motorbike vroom may reach 110 decibels. This is how many decibels higher than the safe level of 85 decibels? This increase of sound is what percent above the safe level? (to the nearest tenth)

14. The roar of a jet plane may reach a decibel count up to 76% higher than 85 decibels. At that rate, what would be the measure in decibels of the roar of a jet plane?

15. Complete the following table:

U.S. Per Capita Consumption of Meat and Fowl
1949-1951 to 1964 and projections to 1980

Type of Meat	Per Capita Consumption			1980 (projected)	Decrease or Increase from 1949-1951 to 1980 (per cent)
	1949 to 1951 (pounds)	1959 to 1961 (pounds)	1964 (pounds)		
Beef and Veal (carcass weight)	71.2	91.3	106.6	117.0	a)
Pork (carcass weight excluding lard)	70.6	64.9	65.4	58.0	b)
Lamb and Mutton (carcass weight)	3.8	4.8	4.2	3.5	c)
Chicken and Turkey (ready to cook)	24.9	35.7	38.5	45.5	d)
TOTAL	e)	f)	g)	h)	i)

[1] One decibel (db) is the faintest sound that can be heard by man. The units are logarithmic, that is, 10 db is tenfold the power of 1, 20 db is 1 hundredfold.

[2] Pain is felt at 145 db. Rock music is usually 100 db or higher and has been shown to destroy hair cells in the inner ears of laboratory animals.

16. Complete the following table to the nearest tenth:

Solid Wastes Produced by Livestock in the United States, 1965

Livestock	U. S. Population 1965 (millions)	Solid Wastes (grams/capita/ day)	Total Production Solid Wastes tons/year (millions)
Cattle	107	23,600	a)
Horses	3	16,100	b)
Hogs	53	2,700	c)
Sheep	26	1,130	d)
Chickens	375	182	e)
Turkeys	104	448	f)
Ducks	11	336	g)

Percent and Proportion

1. In North Carolina, the population increased from 4,556,155 in 1960 to 5,082,059 in 1970. Compute the percent of increase. Urban population in 1960 was 1,801,921 and this increased to 2,285,168 in 1970, while the rural population of 2,754,234 in 1960 increased to 2,796,891 in 1970. What percent of the total increase in the state's population was due to urban increase? To rural increase?

2. Of the North Carolina population increase of approximately 526,000 from 1960 to 1970, there was an increase of 492,000 whites and 34,000 negro and other races. What percent of the population increase was due to whites? What percent was due to negro and other races?

3. The United States produces about 53 million tons of paper and paperboard every year. In 1969, we recycled only about 22% of the paper and paperboard we produced. How many tons of paper and paperboard were recycled?

4. 8,000,000,000 acres of the world are suitable for crops. Only 43 3/4% of this land was cultivated in 1969. If there existed in 1969 approximately an acre of cultivated land for every person, what was the population of the earth?

5. Americans generate approximately 500 tons of garbage per year, Danes only 150 tons. What percent of the total garbage produced by Americans and Danes is produced by Danes?

6. State and National Parks and Forests total millions of acres in North Carolina. Some of these, with approximate acreage, are Nantahala (450,000 acres), Pisgah (479,000 acres), Croatan (152,000 acres), Cape Hatteras National Seashore (28,000 acres), Bladen Lake State Forest (36,000 acres), and the Great Smokies (256,000 acres in N. C.). The State of North Carolina covers an area of approximately 53,000 square miles. What percent of the land is covered by the parks and forests listed here?

7. The average person uses 20 gallons of water per day for showers. 37% of the total household water per person per day is used for showers. What is the average amount of water used per person per day in an average household?

8. Compute the percent of population increase or decrease in the following North Carolina cities between 1960 and 1970.

City	1960	1970	Percent Increase
Asheville	60,192	57,681	
Charlotte	201,564	241,178	
Durham	78,302	95,438	
Fayetteville	47,106	53,510	
Greensboro	119,574	144,076	
Greenville	22,860	29,063	
High Point	62,063	63,204	
Raleigh	93,931	121,577	
Winston-Salem	111,135	132,913	

9. The population of North Carolina was 1,894,000 in 1900 and approximately 5,100,000 in 1970. What has been the percentage increase over that period? How many people does that represent?

10. The following counties in North Carolina had population increases as follows:

County	1960	1970	Percent Increase
Cumberland	148,418	212,042	
Pitt	69,942	73,900	
Wake	169,082	229,006	
Mecklenburg	272,111	354,656	

What was the percentage increase for each county?

11. If on July 1, 1969, the population of the United States was 201,921,000 persons and that was an increase of 2,072,000 over the year before, what was the percent of increase? (Round your answer to the nearest hundredth.)

12. NOISE, NOISE, NOISE! How much is unwanted noise worth? If noisy garbage trucks disturb you, there is a partial solution. Such trucks can be built with sound-deadening equipment to the "tune" of about $100 per truck.

    a) If a city was to buy 20 such trucks, how much would this cost the taxpayers?

    b) If there were 35,000 taxpayers, what would the cost be to each taxpayer?

13. Other products, too, can be constructed so as to cause less noise. However, the consumer has to pay. If an air conditioner sells for $288, an improved model creating less noise might sell for 8% more. What would be the increase in cost to the consumer? What would the selling price be?

14. For the fiscal year 1968, the United States Congress appropriated $200 million for clean-water measures, compared with the $450 million authorized in 1966. Find the percent of decrease from 1966 to 1968.

15. In 1967, 142 million tons of pollutants went into the American atmosphere; 86 million tons from cars, 43 million tons from factories, and 13 million tons from heating and refuse burning. What percent of the 1967 air pollution was caused by cars?

16. An estimate of the number of different insect species is 1 million. About 900 types attack humans, animals, and plants. What percent of the different insect species can be classified as insect pests? (attack humans, animals, and plants)

17. One study reveals that 95 million Americans drink water not meeting federal standards or of unknown quality. What percent of the United States population (using the figure 202,000,000) is drinking water that fits these conditions?

18. If the federal government provides $3.5 billion for waste treatment programs while state and local governments fund $4.7 billion for the same programs, what percent of the total money spent on waste treatment programs is paid by the federal government?

19. In 1966, Americans spent $25 billion of our nation's wealth for packaging. Of this amount, we literally threw away $14.6 billion because of our inability to recycle or indifference to recycling. This is what percent of the total amount spent on packaging in 1966?

20. In 1920, the average amount of waste per American was 3 pounds. In 1970, it was approximately 5.4 pounds.

    a) What was the increase in pounds of waste during this 50-year period per person?

    b) What is the percent of increase?

    c) If the percent of increase remains constant for the next 50 years, how many pounds of rubbish will be tossed per individual by the year 2020?

21. The population of the United States in 1790 was 3,929,000 and in 1890 it was 62,947,000. What percent of the 1890 population was the 1790 United States population?

22. Because of America's lofty standard of living, 203 million of us use up more resources than 2.5 billion people living in less developed countries. How many people in these less developed countries use the same amount of natural resources as the average American?

23. In 1964, industrial discharge to public sewers showed that 80% of 119,714 industrial establishments each used less than 1 million gallons of water per year, and only 4% used from 10-20 million gallons of water each per year.

    a) How many industrial plants used 10-20 million gallons of water per year?

    b) At 80 gallons of water per person per day, 34 pupils would use how many gallons of water per year?

    c) Assume all water used is discharged through the sewage treatment plant. Would the 34 students or an industry using 1,000,000 gallons of water per year produce more sewage? How much more?

24. Accidental Deaths in 1964:

Motor Vehicle Accidents	48,000
Home Accidents	28,200
Work Accidents	11,100
Fires and Burns	8,000
Poisoning	2,100
Drowning	1,500
TOTAL	98,900

Using the table above:

a) Compare by using a ratio the deaths caused by drowning to the deaths caused by fires and burns.

b) Compare by using a ratio the motor vehicle deaths to the total deaths.

c) Compare by using a ratio the motor vehicle deaths to the deaths by work accidents.

25. If the number of automobiles used in Mecklenburg County increased 50% from 1966 to 1970, and automobiles contributed 400,000 tons of air pollution in the county in 1966, how many tons of air pollution were contributed in Mecklenburg County by automobiles in 1970?

26. Brackish water contains 1% salt. Salt water contains 3% salt. If in a container there are 52 gallons of salt water, how much pure water must be added to classify the water as brackish water?

27. If the loss of water in the home is ½ cubic foot in 15 minutes, how many gallons would be lost per day?

28.

	Land Area (in thousands of sq. kilometers)	Population (in millions)
Asia and Far East	21,178	1,483
Soviet Union	22,403	205
North America	21,483	189
Latin America	20,501	192
Rest of the World	49,770	726

Using the above data, express to the nearest tenth of 1 percent the land area and population of each region to the total.

29. According to one source of information, a person living in the Rockford, Illinois area uses 21,000 gallons of gasoline by age 70.

29. (Continued)

a) If he averages 15 miles to a gallon, how many miles will he have driven?

b) If the gasoline costs 36.9¢ per gallon, how much money does he spend on gasoline in a lifetime?

c) If 8.4¢ of the cost per gallon is taxes to support public highways, what percentage of the cost of gasoline goes for taxes?

d) How many dollars has he contributed toward public highways?

30. The federal government budget for pollution control and abatement activities in 1972 will increase significantly over 1971. The 1972 budget is $5,130,000,000. This is an increase of 71%. How much was the budget for 1971?

Measurement

1. According to an estimate, on July 1, 1969, the population of the United States was 201,921,000 persons.

a) Rounded to the nearest million, what would the population be?

b) Rounded to the nearest hundred thousand, what would it be?

2. If the population of the United States in 1960 was 178,464,000, what was the population in 1960 to the nearest million? To the nearest hundred thousand? To the nearest billion? To the nearest hundred million?

3. From 1 square mile of land which is subdivided for homes, 140 acres must be used for roads and open spaces, such as parks or recreational areas. How many acres are remaining for home construction? If we subdivide this area into 3 lots per acre, how many homes can be built on 1 square mile?

4. Open pit mining destroys approximately 153,000 acres of land each year. How many square miles would this occupy?

5. The interstate highway system uses up about 50 acres of land per mile.

a) At this rate, how many acres of North Carolina land would be used for an interstate highway system from Raleigh to Asheville, a distance of 240 miles?

b) How many square miles of land does this represent?

6. Los Angeles has a potential of more than 20,000 tons of air pollution per day.

a) If the area of Los Angeles is about 1,400 square miles, what is the potential pollution output per square mile per day?

6. (Continued)

   b) If 1 mile = 12 city blocks, what is the pollution output per square city block per day.

   c) How many pounds does this equal?

7. Greater Los Angeles gobbles up approximately 70 square miles of open land each year. How many acres of land would this be?

   Suggestion: A pupil might want to make a scale drawing of this area, as well as his own community, and make some comparisons, using subtraction, fractions, decimals, or percent.

8. North Carolina contains approximately one fiftieth of the area of the 50 states, and its area is approximately 53,000 square miles. The population of the 50 states in 1968 was approximately 201,000,000.

   a) What is the approximate area of the 50 states.

   b) What was the approximate average number of people per square mile in the United States in 1968?

9. By the end of 1970, Americans will have discarded 50 billion tons of paper and 4 million tons of plastics.

   a) If this could be compressed into cubes 1 foot per dimension, weighing 50 pounds each, how many such cubes could be created at the end of 1970?

   b) What might be a set of dimensions for a space large enough to hold this waste?

   c) If 35% of this waste could be recycled (at present only about 10% of paper is being recycled), how many cubic feet of space would be saved?

   d) How many pounds would be returned as a usable product? How many tons?

   Suggestion: Find how many rooms the size of your classroom would be needed to contain this waste.

Statistical Measures and Graphs

1. Using the data below, find the average increase in population in the United States per year from 1930 to 1970.

Year	U. S. Population
1930	122,775,000
1950	150,697,000
1960	178,464,000
1970	207,000,000

2. Construct a bar graph illustrating the following:

Year		U. S. Population
1790		3,929,000
1850		23,191,000
1910		91,972,000
1970		207,000,000
2030	(estimate)	400,000,000

3. Use the table below to construct a histogram, then a curved line graph.

Population--the next 100 years

Decade	Population at Beginning of Decade (in billions)
1961-1970	3.06
1971-1980	3.72
1981-1990	4.55
1991-2000	5.55
2001-2010	6.77
2011-2020	8.20
2021-2030	10.06
2031-2040	12.2
2041-2050	15.0
2051-2060	18.3

4. Americans throw away about 5 pounds of rubbish per person a day. Devise your own symbol and key to develop a pictorial graph showing the amount of rubbish disposed of in 1 week by:

a family of 4
a family of 10
your class
teachers in your school
pupils in your school
etc.

5.

	Land Area (in thousands of sq. kilometers)	Population (in millions)
Asia and Far East	15.6%	53.0%
Soviet Union	16.6%	7.3%
North America	15.9%	6.8%
Latin America	15.1%	6.9%
Rest of the World	36.8%	26.0%

Using these percents (rounded to the nearest whole percent), find the median, mode, and mean for the land area and population data.

6. From 800 to 1,000 people die each year from some form of pesticide poisoning. Another 80,000 to 90,000 are injured by these chemicals.

   a) What is the minimum number of deaths and injuries per year caused by pesticides?

   b) What is the maximum number of such deaths and injuries per year?

   c) What would be the median number of deaths each year?

   d) What would be the median number of injuries each year?

   e) What would be the median number of deaths and injuries each year?

7. Phosphates in Detergents

Calgon	75.5%
Axion	43.0%
Biz	40.4%
Salvo	30.7%
Punch	25.8%
Ajax Laundry	25.2%
Spic and Span	23.0%
Breeze	22.2%
Cheer	22.0%
Fab	21.5%
Cold Water All	9.8%
Wisk	7.6%
Trend	1.4%
Ivory Snow	--
Vel	--
Lux	--

   Compute the mean using the data above (to the nearest percent). Find the mode and median.

8. Of the births from 1960-1965 in the United States, 31.8% were born to the poor or near poor. The rest were born to the group classified as the non-poor.

   a) What percentage of the babies born during that period were born to the non-poor?

   b) Construct a circle graph and label to illustrate this division of births.

9. Refer to the Milwaukee County, Wisconsin pollution information on page 34.

   a) How many pounds of air pollution was contributed by transportation in 1966?

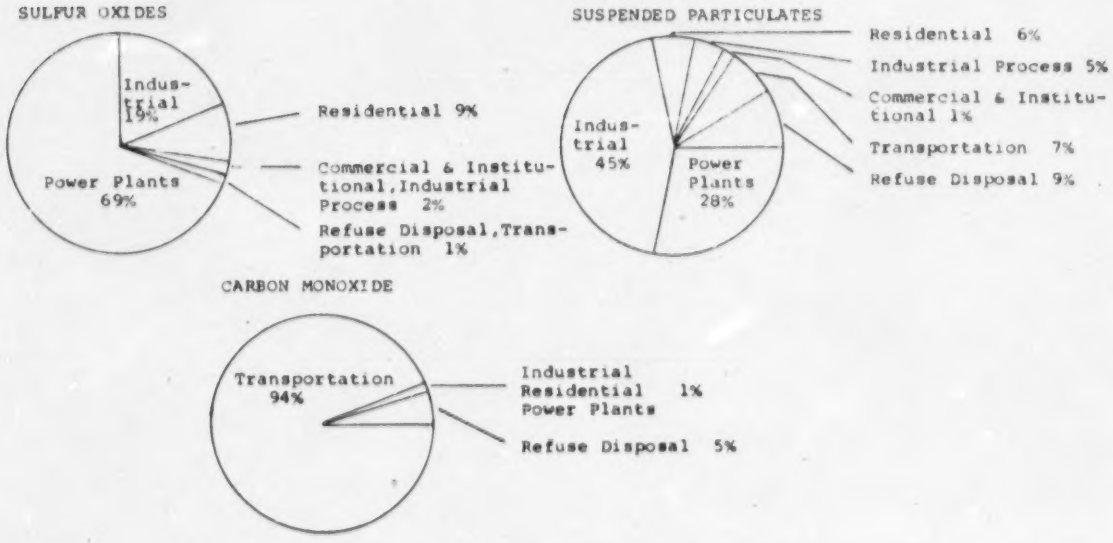
   b) What percent of the carbon monoxide polluting the air in 1966 came from refuse disposal?

9. (Continued)

c) What percent of the "suspended particulates" polluting the air in 1966 came from power plants?

d) Refuse disposal and transportation contributed what percent of the sulfur oxides polluting the air in 1966?

POLLUTION SOURCES



Major contributors to Milwaukee county's air pollution in 1966:

		Per cent
Transportation	432,386	53.2
Fuel burning (mostly heating)	93,270	11.3
Electric power generation	198,092	24.3
Solid waste disposal	32,408	4.0
Manufacturing and processing	57,968	7.2
Totals	813,125	100

Source: 1966 Pollution Source Emission Inventory for Milwaukee County.

10. The average American uses 60 gallons of water per day in the home. The percentage breakdown is the following:

Flushing toilets	41%
Washing and bathing	37%
Kitchen use	6%
Drinking water	5%
Washing clothes	4%
General household cleaning	3%
Watering the garden	3%
Washing the car	1%

a) Make a circle graph to illustrate the above information.

b) Make a bar graph.

	Land Area	Population
Asia and Far East	15.6%	53.0%
Soviet Union	16.6%	7.3%
North America	15.9%	6.8%
Latin America	15.1%	6.9%
Rest of the World	36.8%	26.0%
TOTAL	100%	100%

Using this table, prepare a "double" broken-line graph. (colored pencils will be helpful) You may also wish to represent this information by using circle graphs or pictographs.

12. Using the data below, construct a circle graph for each category: motor vehicles, factories and power plants, refuse, and miscellaneous. Construct a bar graph showing total air pollution comparison between carbon monoxide, sulphur and nitrogen gases, hydrocarbons, and particulates.

AIR POLLUTION IS ONE OF AMERICA'S GREAT PROBLEMS

SOURCES

90 MILLION MOTOR VEHICLES

99% burn gasoline, with pollution from exhaust pipe, crank case, carburetor and gas tank.

FACTORIES AND POWER PLANTS

Especially pulp and paper mills, iron and steel mills, refineries, smelters and chemical plants. Over 90% of power plants in 1969 burned coal and oil containing sulphur to generate electricity.

REFUSE DISPOSAL and MISCELLANEOUS

Each person creates about 1800 lbs. of waste per year.

MILLION TONS POLLUTION				
CARBON MONOXIDE	SULPHUR and NITROGEN GASES	HYDRO-CARBONS	PARTICULATES	TOTALS
65	8	18	1	92
12	38	5	17	72
17	2	4	4	27
94	48	27	22	191

TOTAL MILLION TONS AIR POLLUTION PER YEAR

ANSWERS

PROBLEMS

1. a. 149 cans
   b. 75¢
   c. answers will vary
   d. answers will vary
   e. 11,175 cans

2. a. 1,460 lb.
   b. answers will vary
   c. 547.5 lb.

3. approximately 7 7/9 gal. per week per person

4. 500 lb.

5. I.

	Birth Rate (per 1,000)	Death Rate (per 1,000)	Natural Increase (per 1,000)	Percent Increase (per 1,000)
U. S.	17.6	9.5	8.1	.8%
N. C.	18.4	8.8	9.6	.10%
Your Community				

   II. a. 4.5%
   b. 34 per 1,000
   c. 3.4%
   d. 10,710 births

   III. a. 3.6684 billion or 3,668,400,000
   b. 3.7381 billion or 3,738,100,000

   IV. a. 384,000,000
   b. 160%

6. 25

7. 161,538 lb. or 161,540 lb.

8. a. 20,254 lb.
   b. 20,254,000
   c. 31,590,000 cows
   d. 271,116,260 metric tons per year

9. to 32 degrees F by the year 2563
   to melt by the year 3354

10. 130 2/3 gal.

11. 1970: 20/3
    1965: 130/3

12. approximately 30,914,089 calories

13. Biochemical oxygen demand--the amount of oxygen required by bacteria while stabilizing decomposable organic matter under aerobic conditions. BOD test used to determine the pollutional strength of domestic and industrial wastes in terms of oxygen they will require if discharged into natural water courses in which aerobic conditions exist.

14. 252

15. noise polluter--Howard
water polluter--Robert
land polluter--Tom
air polluter--Andrew

EXERCISES

Whole Numbers

1. 87

2. The effects would be with us through 1985 and therefore, we should be freed of its affects (in theory) by 1986.

3. 526; 1,052; 4,208

4. 5; 117,900 $\mu g/m^3$

5. 135,335 thousands of sq. km.; 2,795 millions

6. 1 day--477,190 lb.
1 week--3,340,330 lb.
1 year--173,697,000 lb. (based on 52 weeks)
174,174,000 lb. (based on 365 days)
1 year--87,000 tons (rounded off to nearest thousand)

7. $250,000,000.00

8.

	Family	Community
water	15 million gal.	15 billion gal.
gasoline	105,000 gal.	105 million gal.
milk	140,000 lb.	140 million lb.
meat	50,000 lb.	50 million lb.

9. 139,906,000

10. 109,500,000,000 gal.

11. 440 million; 880 million

12. 901 million

13. 87,500,000

14. answers will vary

15. 420 gal.

16. 30 days

17. answers will vary

18. 12,000 gal.

19. 70,000 gal.

20. 5,000 gal.

21. a. 45 gal.
    b. 477×10^{10}

22. 207,000,000

23. 300 years

24. a. 3,310,000
    b. 56,303,000
    c. 52,993,000
    d. 199,761,000

25. a. 1,826
    b. 3,652

26. a. 8
    b. 160,100,000,000
    c. 336,200,000,000,000
    d. yes

Rational Numbers

1. a. 46.5 million tons
   b. 24 million tons

2. 6 years

3. 20,250 lb.

4. 1/36

5. 2,333,333,333.3 or 2 and 1/3 billion

6. 90 2/9 million

7. 7 1/5 million

8. $\frac{25,000,000}{3,500,000,000} = \frac{1}{140}$

9. 8 billion acres

10. 1/2

11. 164,000,000 people; 56,000 sq. miles

12. a. $265 billion; $295 billion
    b. $1,261.90; $1,404.76

13. 63,000,000

14. a can

Real Numbers (decimals)

1. approximately 232

2. 1/5, .20; 3/10, .30; 27/100, .27

3. 86.492 million

4. a. 19.1 per 100,000
   b. 14.6 per 100,000
   c. 14.7 per 100,000
   d. 21.4 per 100,000

5. a. approximately 527.8 million acres
   b. 526.8 million acres; 516.8 million acres
   c. 1.9 acres per person

6. 4.06 million Indians

7. 1 hour--5,280 lb. or 2.64 tons
   1 day--126,720 lb. or 63.36 tons
   1 week--887,040 lb. or 443.52 tons
   1 month (30 days)--3,801,600 or 1900.8 tons
   1 year--46,252,800 lb. (one day) or 23,126.4 tons
   45,619,200 lb. (12 months) or 22,809.6 tons
   46,126,080 lb. (52 weeks) or 23,063.04 tons

8.

	a	b
smoke	.7 tons	49 tons
junked cars	.034	2.38
cans	236	16,520
bottles	128	8,960

9. a. 507,500 tons
   b. 4,562,500 tons

10. approximately 24.6 per hundred thousand

11. a. 3.5844 million or 3,584,400
    b. 1.9776 million or 1,977,600
    c. 207.6068 million or 207,606,800

12. carbon monoxide
    a. .7586+ tons or approximately .76 tons
    b. 38 tons (using the .76 tons)

    hydrocarbons
    a. .1989+ tons or approximately .20 tons
    b. 10 tons

    nitrogen oxides
    a. .0746+ tons or approximately .07 tons
    b. 3.5 tons

    lead
    a. .0026+ tons or approximately .003 tons
    b. .15 tons

13. 25 decibels; approximately 29.4%

14. 149.6 decibels

15. a. 64.3%
    b. -17.8%
    c. -7.9%
    d. 82.7%

e. 170.5
f. 196.7
g. 214.7
h. 224.0
i. 31.5

16. a. 1,017.33
b. 19.46
c. 57.65
d. 11.8
e. 27.4
f. 19.0
g. 1.6

Percent and Proportion

1. 1960 to 1970--11.5%; urban--92%; rural--8%
2. 93.5%
6.5%
3. 11.66 million tons
4. 3,500,000,000
5. 23%
6. .04%
7. approximately 54 gallons
8. a. -4.2
b. 19.7
c. 21.9
d. 13.6
e. 20.5
f. 27.1
g. 1.8
h. 29.4
i. 19.6
9. a. 169%
b. 3,206,000
10. Cumberland--42.9%
Pitt--5.7%
Wake--35.4%
Mecklenburg--30.3%
11. 1.03%
12. a. $2,000.00
b. 5.7¢ or approximately 6¢
13. $23.04; $311.04
14. approximately 55.56%
15. approximately 60.6%
16. .09%

17. approx. 47%

18. 42.68%

19. 58.4%

20. a. 2.4 lb.
    b. 80%
    c. 9.72 lb.

21. approx. 6%

22. approx. 12

23. a. approx. 4,789
    b. 992,800
    c. Industry; 7,200 gal.

24. a. 3/16
    b. $\frac{480}{989}$
    c. $\frac{480}{111}$

25. 600,000

26. 104 gal.

27. 360 gal.

28.

	Land Area	Population
Asia & Far East	15.6%	53.0%
Soviet Union	16.6%	7.3%
North America	15.9%	6.8%
Latin America	15.1%	6.9%
Rest of World	36.8%	26.0%

29. a. 315,000 miles
    b. $7,749
    c. 22.76% or 22.8%
    d. $1,764

30. $3.000,000,000

Measurement

1. a. 202 million
   b. 201,900,000

2. 178 million; 1,785 hundred thousands (178,500,000)
   zero billion; 2 hundred million (200,000,000)

3. 500 acres; 1,500 homes

4. 239 1/16 sq. mile

5. a. 12,00 acres
   b. 19 sq. miles

6. a. approximately 14 tons per sq. mile
   b. approximately .097 tons per city block
   c. 194 lb.

7. 44,800 acres

8. a. 2,650,000 sq. miles
   b. approximately 76 people

9. a. 2,000,160,000,000 cubes
   b. answers will vary
   c. 700,056,000,000 cubic feet
   d. 35,002,800,000,000 lb.; 17,501,400,000 tons

Statistical Measures and Graphs

1. 2,105,625

5.

	Land Area	Population
median	16	7
mode	16	7
mean	20.2	20

6. a. 80,800
   b. 91,000
   c. 900
   d. 85,000
   e. 85,900

7. mean--20%
   mode--22%
   median--22%

8. 68.2%

9. a. 432,386
   b. 5
   c. 28
   d. 1

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